PROFILE AND OUTCOME OF PATIENTS REFERRED FOR THORACIC EMPYEMA IN BLOEMFONTEIN, SOUTH AFRICA

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Objective. To establish the profile and outcome of patients referred to the Department of Cardiothoracic Surgery at Pelonomi Hospital, Bloemfontein for management of thoracic empyema. This was considered important in view of the proposed restructuring of health services in the Free State.

Methods. Files of 77 consecutive patients referred to the Department of Cardiothoracic Surgery at Pelonomi Hospital were reviewed. The effect of the condition of the ipsilateral lung on the outcome was statistically analysed. This series was compared with a similar size series from Crawford Hospital in Atlanta, Georgia, USA.

Results. The male-to-female ratio was 6:1. Eighty-three per cent of patients were referred from a hospital. The aetiology included a wide variety of causes, but trauma (56%), destroyed lung (10%) and pneumonia (9%) were the most common causes. Active tuberculosis was diagnosed in 6 patients, and the prevalence of HIV was 16%. Mismanagement had probably occurred in 21 cases (27%), usually involving an intercostal drain left in for too long. Surgery was eventually necessary in 52 cases (68%). The final outcome was good in 64 of the 77 patients (83%).

Conclusions. The high prevalence of surgery requires timely referral to a specialised cardiothoracic surgeon, and facilities should be available. Empyema associated with a diseased lung, especially a destroyed lung, is a therapeutic challenge and the outcome is often unsatisfactory.

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Hippocrates described thoracic empyema in 500 BC.[1] Even today the morbidity and mortality associated with pus in the pleural cavity cannot be underestimated. The principle of management remains to clear the infected material and fill the space with healthy tissue, preferably a fully expanded lung.[2] The initial management with thoracentesis or intercostal drainage, whether it involves image-directed catheters (IDC) or intercostal drains (ICD) with an underwater seal, appears simple. However, ineffective treatment complicates the disease and a more invasive approach is required. The timing and exact procedure used to achieve this are not clear-cut and are determined by the individual patient and available expertise.

The restructuring of health services in the Free State has resulted in the lack of such expertise at Pelonomi Hospital in Bloemfontein and therefore a decrease in the number of available beds at tertiary level. Before the final closure of the Department of Cardiothoracic Surgery at Pelonomi Hospital a study was done to assess the profile and outcome of patients admitted to the Department with the diagnosis of empyema. It was hypothesised that a diseased lung would result in a sub-optimal result. This series was compared with a recent publication by a unit known for its work in the field of empyema, namely Crawford Hospital, Emory University, Atlanta, Georgia.[3] The latter study was a cost-effectiveness analysis in the management of empyema.

PATIENTS AND METHODS

From January 1996 to December 1997, 77 patients were admitted to the Department of Cardiothoracic Surgery with the diagnosis of empyema. Their files were reviewed for aetiology, clinical and laboratory signs of infection, and management. Treatment was categorised into three broad groups: (*i*) no treatment; (*ii*) an intercostal drain; and (*iii*) a surgical procedure. Assessment of the outcome was based on the failure of initial treatment, mortality, and the eventual result in terms of symptoms and radiological clearance. The hypothesis was that a diseased lung would result in a suboptimal outcome. Relevant data were compared with data from the Crawford Hospital study to show similarities and differences in the two series.

STATISTICS

Ninety-five per cent confidence intervals (CIs) for differences in percentages were calculated to compare subgroups.

RESULTS

The 77 patients were an important portion (25%) of all thoracic (non-cardiac) admissions to the Department during the study period. Medical doctors from hospitals referred most of the patients (83%), and 56% were not from Pelonomi Hospital. In fact 22% of patients came from outside the Free State. The mean age was 34 years, and there were 66 male and 11 female patients. Six patients were readmitted and 2 patients required a third admission. Nineteen patients (25%) had symptoms of longer than 6 weeks' duration while the other 58 patients (75%) had complaints of less than 6 weeks' duration.

The basic demographics of the two series are compared in Table I. The differences are interesting. The period of time during which the 77 patients were seen was much shorter at

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Table I. Comparison of the demographic characteristics of the Pelonomi and Crawford hospital series

Pelonomi Hospital	Crawford Hospital
77 patients (over 2 years)	77 patients (over 7 years)
Male/female = 6:1	Male/female = 2:1
Mean age: 34 years	Mean age: 59 years
82% referred	35% referred

Table III. Differences in aetiology between the Pelonomi and Crawford series

Pelonomi Hospital (%)		Crawford Hospital (%)	
Trauma	56	Pneumonia	65
Destroyed lung	10	Post thoracotomy	16
Pneumonia	9	Trauma	5
Other	25	Other	14

Pelonomi Hospital, and the male dominance was more obvious. Patients at Crawford Hospital were generally older.

The clinical picture of the patients at Pelonomi Hospital is shown in Table II. Fever was present in 37% of the patients, while clubbing was seen in only 14%. Anaemia and leucocytosis were common. The chronic nature of the empyema was further confirmed by the low median body mass index of 19 kg/m², and a low albumin level. Organisms were cultured in 70% of specimens. The wide variety of pathogens, in various combinations, did not demonstrate a specific pattern. However, the three most common organisms were *Staphylococcus aureus*, streptococci and *Escherichia coli*. Testing for acid-fast bacilli was positive in 4 sputum specimens and 4 pleural specimens. These were seen in 6 different patients — in 4 patients during the first admission and in 2 during a readmission. Antibodies for HIV were positive in 11 of 67 specimens (16%). CD4 counts were not done. Four of the 8 female patients tested (50%) were HIV-positive compared with 7 of 59 tested males (12%). The combination of HIV and tuberculosis (TB) was seen in only 1 patient. The prevalence of HIV was not mentioned in the Crawford study. Empyema was present in 40 right (52%) and 37 left (48%) pleural spaces. A diseased underlying lung was present in 24 patients (31%) as established by the clinical history, all the available chest radiographs (CXR), and the assessment at surgery. Computed tomography (CT) scan was done in 9 patients, with 7 patients demonstrating a diseased lung.

Table II. Clinical picture of empyema patients at Pelonomi Hospital

Fever (%)	37
Clubbing (%)	14
Body mass index	50% ≤ 19 kg/m²
Haemoglobin	65% < 12 g/dl
White cell count	50% ≥ 11 x 10⁹/l
Specimen culture	70% culture +ve
Albumin	90% ≤ 38 g/l

The differences in aetiology are between the Pelonomi and Crawford series patients are shown in Table III. Trauma was the major cause of empyema at Pelonomi Hospital, whereas in the Crawford series it was associated with parapneumonic effusion. Fifteen other causes were seen in 19 patients. These include spontaneous pleural pathology, subdiaphragmatic diseases, mediastinal involvement and various other lung conditions.

Twenty-one patients (27%) were considered to have been mismanaged. In the vast majority of instances (18 patients) this involved an ICD that had remained in too long before the patient was referred for another opinion. The mean duration of drains in these patients before referral was 25 days (range 6 - 90 days), with a standard deviation (SD) of 20 days. In 3 cases mismanagement involved a wrong diagnosis and inaccurate interpretation of the CXR. A tragic example is the patient in Fig. 1 who had two intercostal drains inserted for a pneumothorax following a stab wound to the chest. After a week the patient was sent to Pelonomi Hospital where the presence of a perforated stomach in the pleural cavity was confirmed at surgery. A second example is illustrated in Fig. 2.

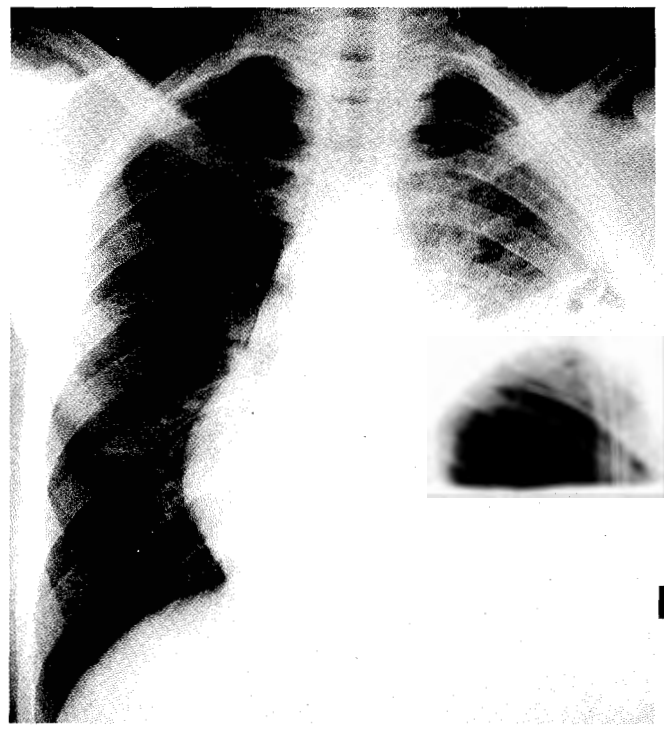

Fig. 1. Two chest drains are in place for a stabbed chest with a perforated stomach in the left pleural space.

Fig. 2. Three chest drains were inserted over 3 weeks for a non-expanding lung after a stabbed chest.

This patient had three ICDs during the course of 3 weeks following a chest stab before it was decided that no progress had been made. A third extreme example involved a patient with a destroyed lung who had an ICD in for 3 months before being referred to our Department.

Table IV depicts the initial management at the two hospitals. Two patients at Pelonomi did not receive any treatment. One was referred as a case of parapneumonic empyema, but on admission the patient was found to be asymptomatic with a clear CXR. The other patient refused any form of management. In 32 patients (42%) the initial form of treatment was an ICD, which was usually inserted by the referring doctor. Surgery was offered to 43 patients (56%) on grounds of the clinical picture and the CXR. Decortication where the pleural space was cleared and the collapsed lung freed to expand was undertaken in 35 patients. An open thoracostomy (a modified version of the Eloesser procedure[4]) was performed in 6 cases, and finally 2 patients needed pedicled chest wall muscle flaps to fill the pleural space because of a lung that appeared unable to expand completely. Nine patients with initial ICDs

Table IV. Initial management at Pelonomi and Crawford hospitals

Pelonomi Hospital	(*N*)	Crawford Hospital	(*N*)
No treatment	2	No treatment	4
ICD	32	IDC and ICD	44
Surgery	43	Surgery	29
Decortication	35	Decortication	17
Thoracostomy	6	Muscle flap	12
Muscle flap	2		

ICD = intercostal drain; IDC = image-directed catheter.

subsequently required a surgical procedure (8 decortications and 1 thoracostomy) either during the first admission or on readmission. Four patients with decortications required follow-up surgery — 2 had a conversion to a thoracostomy, 1 had a repeat decortication and 1 had a chest wall defect closed with a muscle flap. Two of these 4 patients turned out to be TB-positive. This resulted in 52 patients (68%) having surgery. A bronchoscopy was done in those patients with a spontaneous empyema or unknown aetiology. No pathology was found.

In the Crawford series 4 patients were considered too sick for an invasive procedure. IDCs were inserted in 20 patients and ICDs in 24 patients. Decortication (17 patients) and muscle flaps (12 patients) were the initial surgical procedures at Crawford Hospital. In that study primary management failed in 39% of patients treated with IDCs or ICDs, and further ICDs (3 patients) or surgery (14 patients) were required. Therefore eventually 56% of patients underwent surgery.

At Pelonomi Hospital 9 patients from the ICD group converted to a surgical procedure. If one adds the 1 death, 1 patient with persistent drainage and 3 with suboptimal radiological clearance, the total failure rate in the ICD group was 14 of 32 patients (44%). The risk of failure at Crawford was greatest for multiloculated empyemas. At Pelonomi 13 of the 24 patients (54%) with a diseased lung had a satisfactory result after initial treatment compared with 41 of 53 (77%) of those with a healthy lung. This difference was statistically significant with 95% CI from 0.3% to 46.1%. The duration of symptoms (longer than 6 weeks' duration compared with less than 6 weeks) had no influence on the outcome.

The 6.5% mortality rate at Pelonomi Hospital (5 patients) is lower than 13% at Crawford Hospital (10 patients, including all 4 patients who were treated with antibiotics only). One patient died the day after admission. She was cachectic, jaundiced, had a destroyed lung and was in renal failure. Two other patients with a destroyed lung who had had thoracostomies died of respiratory failure. Another patient, with a perforated stomach for 3 weeks after a stab wound to the chest, died suddenly 16 days after his thoracotomy, and a fifth patient died from pneumonia in the contralateral lung 2 weeks after decortication.

Two subgroups need special reference — those with a destroyed lung and those who were HIV-positive. Eight patients had a completely destroyed lung. A destroyed lung refers to severe loss of lung parenchyma as a result of fibrosis and cavitation. Six patients were aware of having had TB in the past, and 2 had active TB at presentation. One patient was HIV-positive. The management of the 8 patients involved 3 ICDs, 4 thoracostomies, and 1 decortication with a pedicle muscle flap to obliterate the pleural space. Only 1 ICD was successful; the patient in a bad general condition with an ICD died the day after admission; and 1 ICD failed, but the patient refused further management. Two patients with thoracostomies died

and 2 with thoracostomies left the hospital in a satisfactory condition. The 1 patient with a decortication and muscle flap had a good result.

HIV was detected in 11 patients (16%). AIDS played no role in their aetiology and they did not differ from the rest of the group as far as the cause of the empyema was concerned, i.e. trauma as the main causative factor. Six patients had an ICD, which failed in 3. Surgery was eventually offered to 6 patients. In the end 8 patients had a good result.

After second procedures and readmission the final outcome was good in 64 patients (83%). Mortality is inevitable, but the 5 deaths should still be considered failures. Two patients refused management. In 3 cases the patient was happy, but the CXR was not completely clear. Three patients had consistent but low-volume drainage at the time of discharge from hospital. Their lungs were fully expanded, and they did not return to the cardiothoracic clinic.

DISCUSSION

The clinical picture confirmed the chronic nature of empyema thoracis. Anaemia and leucocytosis were often present, but only one-third of patients had fever. Being apyrexial did not necessarily exclude the presence of pus in the pleural cavity. Poor general nutritional status was also evident. The 70% positive culture rate was higher than expected considering the fact that the vast majority of patients were treated elsewhere, often with systemic antibiotics. Anaerobic organisms were not cultured, but specimens were not plated specifically for it. Anaerobic organisms could have been present.[5] The term 'tuberculosis empyema' is often used when it is actually a bacterial infection of the pleural space in the presence of pulmonary TB.[6] It could be expected that in future the pulmonary complications of AIDS will contribute more to the aetiology of thoracic empyemas. In a study conducted in sub-Saharan Africa the association of HIV with empyema has been found to be as high as 66%.[7]

The comparison of the two groups in terms of patients (Table I) and aetiology (Table III) indicates the different societies at risk. The Crawford series spans a period that is three and a half times as long as that of the Pelonomi study. Parapneumonic effusion, the most common cause of thoracic empyema, is seen in many series from developed countries.[8,9] These patients tend to be older than the Pelenomi ones, whose mean age was 34. The male-to-female ratio of 2:1 has been described before.[10] The 9% prevalence of parapneumonic empyema in the Pelonomi group is low. Trauma was by far the most common cause of empyema at this hospital and confirms the violent nature of our society[11] (both the trauma and the secondary development of empyema are preventable). The aetiology explains the predominance of male patients in this series. Of great concern is the high number of patients who could have been referred earlier to prevent the formation of empyema after haemothorax, or who could have been treated more effectively, even to the extent of preventing death, as evidenced by 1 patient in this series. This proves the specialised management required for this disease.[12]

While there are many ways to manage thoracic empyema, the most effective treatment remains controversial.[13] In the natural course of a thoracic empyema there are three phases.[14] Initially there is an exudative phase, in which the fluid is thin, with a low cellular count. This is followed by a more fibrin-purulent phase with more polymorphs, fibrin deposits and less fluid; and eventually there is an organising phase where the liquid is thick and fibroblasts invade the visceral pleura of the lung. Drainage is more effective in the beginning and decortication becomes difficult in the last stage.

The high failure rate associated with IDCs is related to multiloculated effusions and probably to small-diameter catheters. Even the larger ICDs fail frequently. A more aggressive approach will often result in fewer treatment failures.[15] In a large series of 500 patients Le Roux[16] used a procedure other than an ICD in 83% of patients. He advocated the distinction between 'thin' and 'thick' pus, together with 'sick' or 'healthy' patients. This paved the way for simple drainage (ICD), open drainage or further investigations to assess the ipsilateral lung with a view to doing a decortication. With bronchograms no longer available, high-resolution CT scanning of the chest could offer an evaluation of the lung. Expansion of the lung depends on compliance. Young patients with an empyema following a penetrating chest wound probably do not require a CT scan. A bronchoscopy is indicated in patients with a spontaneous empyema to exclude a foreign body or malignancy.[17]

The principle behind the thoracostomy is to drain the infected pleural space and to rely on the gradual re-expansion of the lung, or once the space is clear either to resect the diseased lung or obliterate the pleural space with chest wall muscle. The latter is a mutilating procedure, but not to the extent of a thoracoplasty. The rib resection, as described by Le Roux, was not performed in this series.[17] A prosthesis for open thoracostomy may combine the rib resection with that of an Eloesser thoracostomy.[18]

Other techniques have not been used in this group. Use of streptokinase was described in 1949.[19] Bleeding was a problem, but the appropriate dose has corrected this. Frequent instillations of streptokinase are necessary and the result depends on a small cavity and no loculations. A useful method, especially in the prevention of empyema after a traumatic haemothorax, is the early evacuation of the residual blood with thoracoscopy.[20] Even with established empyema it is a way of dealing with the loculations and a chance to insert a well-positioned drain. Although it would have been ideal in this series, it was not an option at Pelonomi Hospital. Pleural

irrigation was not applied as a form of treatment. A few patients were irrigated at the referral hospital. Irrigation is associated with complications such as antibiotic resistance, nausea, systemic absorption and lack of penetration of the cortex.[17,21] An air leak from an alveolar-pleural or broncho-pleural fistula complicates or prohibits irrigation. The effect is also limited by loculations and the success rate is not convincing. In a series by Conlan *et al.*[22] 60% of patients had still not completed their treatment after 14 days of irrigation with taurolidine. Ridley and Braimbridge[23] saw a similarly disappointing result in their study of 18 patients — only one-third were cured by irrigation alone and the rest required further surgical intervention. Empyema secondary to pulmonary resection with or without a broncho-pleural fistula is a topic on its own.[24] At Pelonomi 1 patient was treated satisfactorily with an ICD after an empyema developed secondary to a lobe resection for a lung abscess.

The destroyed lung with empyema is difficult to treat. With an ICD the pus is cleared, but not the source. A decortication could be disastrous. In the local series obliteration of the pleural space with a pedicled chest wall muscle was successful in 1 case. Ideally the lung should be resected, but these patients are chronically ill, have limited reserves for a major procedure and run the risk of post-resection empyema.[25] A thoracostomy seems a reasonable and safe way of management.

CONCLUSION

Empyema thoracis remains a common disease, but management can be complicated. Lack of timely referral, the high prevalence of surgical procedures necessary, and the associated mortality obliges the thoracic surgeon to deal with an empyema. Within a few days the success of an ICD should be assessed in terms of drainage and lung expansion on CXR. A CXR suggestive of abnormal lung parenchyma should alert the attending physician to the need for early referral. The Crawford series concluded that early surgery could be as cost-effective as primary intervention, and more cost-effective when primary intervention fails.

For the benefit of the patient and the taxpayer, third-level health care facilities should be made available for the management of empyema. A scaling down of tertiary beds would be detrimental to both these role players.

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